<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th>The impact of digitalisation on broadcasting.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Author(s)</strong></td>
<td>Lebbay, Omar.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>1996</td>
</tr>
<tr>
<td><strong>URL</strong></td>
<td><a href="http://hdl.handle.net/10220/1304">http://hdl.handle.net/10220/1304</a></td>
</tr>
<tr>
<td><strong>Rights</strong></td>
<td></td>
</tr>
</tbody>
</table>
THE IMPACT OF DIGITALISATION ON BROADCASTING
By Omar Lebbay
Asia Broadcast Centre*

Introduction

In order to understand the impact of digitalisation on broadcasting, we would have to have a clear understanding of what “digitalisation” means.

Digitalisation or what is sometimes referred to as quantisation, is the process whereby an analogue signal is sampled and each sample’s value is assigned a specific binary code of 1’s and 0’s. All natural phenomenon are analogue, for example sound and light—the basic elements of a Television signal. Digitalisation is the process of transforming those analogue pictures and sound into bits of information consisting of the numbers 1 and 0. That information is transmitted into various media and reconstituted at the receiving end to form the analogue signals that you see in your television set.

Historical Background

Television is essentially an electronic mass media. Digital recording is not new. Digital audio recording was developed as early as 1958 by Max Matthews at the Bell Telephone Laboratories. Digital technology has since then been applied to virtually every facet of development in electronics. The explosive growth of digital technology has been fueled by the demand for inexpensive yet high performance computers and data storage devices. Television technology has directly benefited from this technological advancements and the falling cost of digital electronics over the last two decades.

As early as 1979 Sony, Ampex and Bosch demonstrated prototype digital video tape recorders (VTRs). The CCIR 601, EBU/SMPTE standard was adopted in 1981. In 1987 Sony unveiled the D1 format DVR 1000. In 1988 Sony and Ampex jointly introduced the D2 format which very quickly became the digital replacement for analogue VTRs. Panasonic developed the D3 format in 1990 followed by the Ampex DCT format in 1991. These formats had only a token following. Sony developed the Digital Betacam format in 1993 which is now the de facto industry standard.

Analogue Vs Digital

When Television was developed it was based on analog concepts and analog electronic circuitry. Analogue circuits have very severe technical limitation with respect to the degenerative quality of the analogue signal. The negative artifacts of recording /dubbing

---

Paper presented at the seminar on “Update on Communication Technology” organised by the Asian Media Information and Communication Centre. Omar Lebbay is the training Manager of Asia Broadcast Centre. The author would like to acknowledge the invaluable input for this article by Mr. Rodney Jay and Virgilio S Labrador, General Manager and Marketing Manger respectively of Asia Broadcast Centre
and signal processing also live in the analogue domain and cannot be effectively removed. Virtually none of these degradation is present in a pure digital signal. The TV signal is analogue by nature as are all things in the real world. Noise and interference are also real problems in the analogue world. In addition the analogue TV signal does not lend itself to easy manipulation for standards conversions and creative use.

Applying digital technology to the analogue TV signal makes it possible to overcome both analogue noise and interference. This is because digital signals are absolute in value and time and do not change. Once the TV signal is in the digital domain, signal manipulation for special effects and graphics/video integration is limitless. The film industry has produced excellent examples of such integration. Terminator, 4th of July etc.

**Analogue to Digital Conversion**

To convert the continuous analogue signal into a digital signal it has to be sampled and a value assigned for each time the signal is sampled. The sampling rate determines how many samples are taken. An infinite sampling rate would give the most accurate reflection of the original analogue signal. In practice the luminance is normally sampled at 4 X 4.43 Mhz (PAL color Subcarrier frequency) and each of the two color difference signals are sampled at 2 X 4.43 Mhz. This is known as the 4:2:2 or original D1 standard. Sometimes it also known as the CCIR 601 uncompressed standard. This is the first step in the Analogue to Digital conversion process. The reverse process or Digital to Analogue conversion will restore the original analogue signal.

**Transmission Techniques**

Once the analogue signal has been converted to a digital signal there are two modes of transmitting the digital signal. The parallel technique sends each bit channel via a separate path. Thus, an 8 bit system would require 8 channels or pathways to deliver the signal.

On the other hand serial transmission employs complex coding techniques to interleave in time sequence the bits in each parallel channel into a single pathway.

Within systems where the distance covered is relatively short the parallel technique is employed. Whereas if the signal needs to be delivered between systems for longer signal travel, the serial technique is more practical as only one signal path is required.
Digital Compression

Once the TV signal is in the digital domain then digital compression techniques maybe applied to the signal to save space and cost on storage delivery systems. It must be borne in mind that any compression applied would compromise the picture quality. The two factors to be considered are:

- What level of compression is tolerable to the viewer
- Intended use of the compressed signal

Generally, digital compression falls into two categories:

- Those that require moderate to high compression to utilise the limited bandwidth capacity of transmission channels to achieve cost efficiency
- And those that make use of low compression ratios to preserve broadcast quality for video and post-production

Assuming off-line editing quality would suffice it would take 2 GB of storage space to hold and hour of compressed video at a ratio of 35:1. Offline editing refers to the rough cut for viewing and editing guide only. If we want the video materials to maintain some of its original robustness we would need to settle for a lower 10:1 compression ratio. At that ratio we would need to purchase 8 GB of storage for the same 1 hour of material. That gives us a rough concept of the cost/compression trade off.

Typically a single pass compression system like MPEG 2 is only intended to be encoded and decoded once and is visibly tolerable at the lowest 13:1 compression ratio. However fast moving complex backgrounds and sports events may suffer “motion artifacts”. The highest compression on MPEG 2 maybe 25:1. Compare that with the mild 2:1 standard adopted by SONY on the Digital Betacam. The 2:1 standard is probably the highest compression that may be tolerably applied for broadcast quality multi-generation dubbing and frame accurate editing in post production environments.

High Speed Video Data Transfer

Currently video information transfer has been “Real Time” meaning that an hour of video will take an hour to record/copy/transmit/broadcast or convert. Once digitised the video information becomes data. So together with a 10:1 compression technique Sony has introduced a new SX format that allows for high speed video data transfer. This system claims data transfer four times the normal “Real Time.” Imagine what this high speed possibility gives news and current affairs producers in terms of lead times and satellite uplink costs.
Satellite Broadcast Delivery.

The biggest factor in satellite transmission has been the prohibitive cost of leasing satellite transponders. Utilising current MPEG 2 encoding/compression techniques up to eighteen MPEG 2 data streams maybe multiplexed into a single MPEG 2 transport stream. Each MPEG 2 data stream can carry one video and up to four audio channels. The multiplexed single MPEG 2 transport stream can be uplinked via one transponder. That would be really stretching it to the limits.

A single analogue TV channel is currently occupying the whole of the 54 MHz bandwidth on a typical transponder. In practice two broadcasters could co-lease a transponder and use 27Mhz each. That would see them comfortably delivering six MPEG 2 data streams via their half of the transponder. In essence it averages twelve TV channels per transponder. That's very good news for satellite broadcasters.

Whether the goal is to reduce costs or to provide additional programming, programmers and broadcasters alike will benefit from this technology. The ability to send multiple, digitally compressed channels in a single satellite transponder reduces cost and allows programmers to economically add new revenue generating services. Digital encryption or scrambling ensures that only authorised digital satellite receivers can unscramble and receive these revenue generating services. Secure distribution of selected programming protects transmissions from unauthorised use. From a ecological standpoint we would need less satellites to deliver more and more data and TV channels. It would improve the satellite debris in space.

The Direct To Home or DTH market

There is tremendous potential in this market given the ability of MPEG 2 digital streams to be multiplexed with outputs from file servers, local programming and satellite sources to feed satellite transponders for downlink and remultiplex for double hops or cable networks to DTH set top boxes (STB). This makes available to the DTH viewers a massive choice of channels. As cities gear up for house to house fibre optics then the need for terrestrial transmissions as we know it today will slowly diminish in cities. We are already seeing this happening in Singapore today. The local channels will be integrated into massive DTH services. Alternatively for areas where cable access is not possible MMDS or Multipoint microwave distribution systems will be used to feed MATV or CATV (Master or Central antenna systems) carrying the same channel densities to the viewer. Terrestrial TV will be confined to remote areas only. Even then if DBS is allowed by the broadcasting authority these remote areas can also receive programming direct from satellite.
The Pan Asia TV market?

Broadcasters who are new to the region may have plans for the so-called “Pan Asia” market. When they get here it dawns on them that there is no such homogeneous market. But there is the:

- Indian market
- Mainland Chinese market
- Taiwanese market
- Thai market
- Philippine market
- Indonesian market

and so on.

So digital television with multiple channels per transponder is a real boon as it allows cost effective “customisation”. It enables the broadcaster to utilise the same main programme feed and then “customise” individually with different subtitles, different voice overs, different interstitials and so on to target the audience in the specific markets.

Benefits of Digital Technology

Going digital makes possible:

- Data encryption (scrambling).
- Better signal quality.
- Ease of signal recovery.
- Greater noise immunity.
- Repeatability and reliability.
- Low cost of delivery
- Maximise use of available bandwidth

In addition, digital technology lends itself well to cross-media uses. Digital information can be transmitted through various media such as cable, via phone lines and through the INTERNET. This will make possible many services such as interactive television, pay-per-view and Video On Demand (VOD).

Costs of Digital Technology

There is definitely a cost/benefit criteria for anyone to jump on the digital bandwagon. We have already discussed the many benefits of DVB. To receive and redistribute DVB, cable headend operators need to be supplied with the necessary Digital Video Broadcast IRD’s (Intergrated Receiver Decoders). It is a simple matter in Singapore where we have
only one cable operator. However imagine the Indian sub-continent with more than twenty thousand head end cable operators. The cost would indeed be prohibitive. Currently no programmer or broadcaster has found it cost effective to go DVB in India.

Those broadcasting facilities that have made substantial investments in their analogue systems would find the initial cost of installing digital equipment prohibitive. There is also the cost of constantly upgrading digital equipment which changes very rapidly. Unfortunately at this stage there is also not only one form of digital encoding equipment, so in many cases, the decoder costs cannot be amortised over a large number of channels. For example, Discovery is using one form for its Asian channels but if you wanted to receive Star TV you would need another type of decoder.

Asia Broadcast Centre in Singapore is Asia’s newest and largest independent production, post-production, playback and satellite facility. Having been recently established in mid-1995, it had the advantage of building an all-digital facility from scratch. Asia Broadcast Centre is one of the best integrated all-digital facilities in the world. It uses a serial digital router (132x132) to interconnect the equipment on-site. The principal playback format is Digital Betacam. Customisation of material is provided for clients such as the Discovery Channel through the use of the Digital Betacam format which allows four different audio tracks. A Textronics profile hard disk cache machine used in tandem with an Odetics TCS-90 automated cart machine also allows four different promotional and interstitial material to be played simultaneously.

When evaluating the switch to digital systems many factors must be considered including long-term cost and the potential rate of return. In some cases analogues systems may be enough to serve certain areas, especially small geographic areas with a limited market. While digital systems have economies of scale when serving larger markets.

Conclusion

Digitalisation has made possible:

• Pristine picture quality that is transparent throughout the production and transmission process.
• With digital compression has reduced the cost of storage.
• DVB with compression has reduced the cost of satellite delivery.
• DVB with compression has made possible low cost programme customisation.
• DVB with compression has simplified multi standard transmission via satellite.
• High speed video data transfer will save both production time and cost.

• Serial Digital has simplified audio/video cable transmission and routing.

• Proliferation of DTH services with a slowly diminishing terrestrial market.

In summary digitalisation has delivered on many of the broadcasters aspirations with some compromises. The most important being the cost/quality and cost/benefit issues.